THE DEPARTMENT OF ENERGY'S BUDGET REQUEST FOR FY 1998

Hearing of the Subcommittee on Military Procurement
Committee on National Security
U.S. House of Representatives

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OPENING REMARKS

Mr. Chairman and members of the subcommittee, I am the Director of the Lawrence Livermore National Laboratory (LLNL). Our Laboratory was founded in 1952 as a nuclear weapons laboratory, and national security continues to be our central mission.

I am here today to report on the Stockpile Stewardship and Management Program, which is being implemented by the Department of Energy's Office of Defense Programs at the three national security laboratories (Livermore, Los Alamos, and Sandia), the Nevada Test Site, and the four production facilities (Kansas City, Pantex, Savannah River, and Y-12). Through this highly integrated national program, we are maintaining confidence in the safety and reliability of the U.S. nuclear weapons stockpile without nuclear testing or new weapon development.

I am also here to report on the other major thrust of our national security work—preventing and countering the proliferation of weapons of mass destruction. Work in this area is supported primarily by the Department of Energy's Office of Nonproliferation and National Security. Analysis, policy support, and technology development activities build on and reinforce Livermore's expertise in nuclear weapons and weapon technology.

Livermore is committed to maintaining confidence in the U.S. nuclear stockpile and to stemming and countering the proliferation of weapons of mass destruction. Our goal is to apply the very best science and technology to enhance the security of the nation and make the world a safer place.

INTRODUCTION

Two critical and linked decisions have now established the course for the nation's nuclear weapons program. The President announced on August 11, 1995, that the U.S. would pursue a Comprehensive Nuclear Test Ban Treaty with no permitted nuclear weapon test explosions. In making that decision, he reaffirmed the importance of maintaining a safe and reliable nuclear weapons stockpile. Then, on September 25, 1995, the President directed necessary programmatic activities to ensure stockpile performance. The Stockpile Stewardship and Management Program was developed and is being implemented. On September 24, 1996, the Comprehensive Nuclear Test Ban Treaty was opened for signature at the United Nations and signed that day by the President.

All elements of the Stockpile Stewardship and Management Program are focused on the stockpile—how we will continue to assure confidence in it and how we will address any problems that bring its safety or reliability into question. We must be confident in the nuclear weapons themselves, in the system that maintains them, and in the judgments of the technical staff, who will rely on experimental and computation tools to obtain needed data.

Significant milestones were achieved this year, for the Program as a whole and at Livermore. On December 19, 1996, the Secretary of Energy signed the Record of Decision for the Stockpile Stewardship and Management Programmatic Environmental Impact Statement, which defines the overall architecture of the Program. The implementation plan is already in its first revision, specifying roles and responsibilities for Program participants. The comprehensive effort to provide the first Annual Certification of the U.S. stockpile under the Stockpile Stewardship and Management Program was completed on February 7, 1997, assuring this year the safety and reliability of the stockpile without the need for nuclear explosive testing.

Investments are being made in the new experimental and computational capabilities required for stockpile stewardship and management, and we thank the Committee for their support in making this possible. At Livermore for example, we took delivery of the first elements of our next-generation supercomputer. This new machine, being developed in partnership with IBM, is enabling us to vastly improve our simulation models and accomplish in minutes what otherwise would take weeks. Also this year, Livermore was selected as the site for the National Ignition Facility (NIF) and construction will begin soon. This 192-beam laser facility will provide the means for investigating the thermonuclear physics of primaries and secondaries in nuclear weapons.

To succeed stockpile stewardship and management requires effective integration among the laboratories and the plants of essentially all Program activities. It also requires strong and continuing support and adequate investment—approximately $4 billion per year for a decade. Robust support early in the Program is particularly vital because of the need to bring into operation necessary scientific capabilities while there remain experienced nuclear designers to train the next generation of stockpile stewards. The budget request for FY 1998 provides $4.0 billion for next year's activities. The request also includes total funding for construction of the NIF so that we can most efficiently plan and manage the project and complete it in 2003.

Livermore's national security responsibilities extend beyond stewardship of the U.S. stockpile. The proliferation of weapons of mass destruction (WMD)—nuclear, chemical, and biological—is a growing threat to national security. Instabilities that have resulted from the break up of the Soviet Union have given rise to new threats, particularly as related to surpluses in nuclear materials and nuclear weapon know-how. In addition, we must deal with the increasing threat posed by regional instabilities and the desire (stated or covert) of nation-states to acquire weapons of mass destruction. We must also focus on the growing and particularly worrisome threat of WMD terrorism.

A multipronged approach is needed to counter these WMD threats. The Department of Energy and its national security laboratories apply the expertise gained in their nuclear weapons work, together with their extensive experience in chemical and biological sciences, to support U.S. arms control and nonproliferation policy and analyze weapons activities worldwide. Livermore is tackling the proliferation threat at all stages—prevention, reversal, response, and avoiding surprise.

The scientific and technical issues posed by stockpile stewardship and management and by WMD nonproliferation are extremely challenging. I will discuss Livermore's work in these vitally important areas and provide examples of recent accomplishments, partnership activities, and new initiatives. I will then mention some laboratory management issues and close with a short summary.

STOCKPILE STEWARDSHIP AND MANAGEMENT

The DOE Stockpile Stewardship and Management Program

The Assistant Secretary for Defense Programs has led the Department of Energy (DOE), its three national security laboratories, and other facilities in the weapons complex in the development of the DOE Stockpile Stewardship and Management Program. The Record of Decision for the Programmatic Environmental Impact Statement (issued in December 1996) formally defines the architecture of the Program. In addition, an implementation plan has been developed by the Department, working closely with the laboratories and the production plants. Already in its first revision, this plan delineates specific roles and responsibilities. The Program's overall architecture and implementation plan are driven by consideration of existing capabilities and facilities, scientific and technical requirements that call for new investments, and the need for cost efficiency.

The Stockpile Stewardship and Management Program is designed to ensure the safety and reliability of the U.S. stockpile in an era of no nuclear testing, no new weapon development, a production complex with reduced capacity and capability, and an aging stockpile of fewer weapons and fewer types of weapons. The Program consists of three major elements:

- *Enhanced surveillance: to predict and detect the effects of aging and other stockpile problems*. An enhanced surveillance program does not mean simply more surveillance; it means smarter surveillance. With fewer types of weapons in the stockpile and reduced capabilities and capacity in the production complex, we must become more proficient at detecting and predicting potential problems early to provide adequate time for thorough evaluation and action before problems affect stockpile safety or reliability. A systematic refurbishment and preventative maintenance program geared to the capacity of the downsized production complex requires enhanced surveillance together with predictive capabilities.

  Enhanced surveillance calls for research and development in three areas. First, we must improve databases on the characteristics and behavior of stockpiled weapons so that we can identify anomalies in aging weapons. Second, we must improve the sensors and techniques used to inspect stockpiled weapons. Finally, we must develop a better understanding of how aging alters the physical characteristics of weapon materials and how these changes affect weapon reliability and safety. Success in these scientific efforts enable an affordable manufacturing capability in the production plants.

- *Assessment: to analyze and evaluate effects of changes on weapon safety and performance*. The Stockpile Stewardship and Management Program includes a comprehensive set of activities to address issues that arise from enhanced surveillance and to evaluate the significance of observed and predicted aging processes. When modification actions are deemed necessary, we must assess the viability of options for refurbishing or replacing specific warhead components and the viability of new production and fabrication processes and materials.

  To the extent possible, our assessments must be based on scientific and engineering demonstration. We must rely on aboveground nonnuclear testing in more capable experimental facilities and numerical simulation with advanced computer models. Demonstration-based assessments—now no longer including nuclear testing as a tool—provide the foundation for formal validation and certification of stockpile safety, reliability, and performance.

Essential components of this demonstration basis include new experimental facilities such as the National Ignition Facility, subcritical experiments at the Nevada Test Site, and enhanced computational tools developed through the Accelerated Strategic Computing Initiative. These investments will provide essential data for stockpile stewardship and management. They also enable the retention of nuclear weapons expertise in a staff that will increasingly have no nuclear test experience. We must nurture and exercise the scientific judgment of the next generation of stockpile stewards.

- *Manufacturing: to refurbish stockpile weapons and recertify new parts, materials, and processes*. Production facilities—including those for tritium—must be flexible, highly capable, yet affordable. Cost constraints and the planned much smaller stockpile of the future set our focus on capability, not capacity. Choices of production technologies will emphasize flexibility and quality (free of defects) and will utilize modern commercial methods wherever possible. Manufacturing is a particularly demanding challenge because the plants must contend with extensive infrastructure and operational problems as well as production technologies that are badly in need of modernization.

  The laboratories and plants are working closely together to integrate the development of replacement parts with the development of new materials and manufacturing processes. This concurrent engineering approach reduces costs and provides flexibility to respond to potential needs rapidly. Success in this area depends on our ability to develop computational models of the performance of replacement weapon components and materials and our ability to simulate manufacturing processes so that we can evaluate production options efficiently and accurately.

Integrated Program Management and Validation

The three major elements of the Stockpile Stewardship and Management Program—enhanced surveillance, assessment, and manufacturing—are tightly interconnected through integrated program management. The stewardship and management process is continual, with no clear ending of one phase before the beginning of another. The laboratories and plants are developing comprehensive life-extension plans for each weapon system in the enduring stockpile. These plans integrate surveillance, assessment, life-extension manufacturing activities on a weapons system by weapons system basis, and time-phase all activities (to the extent possible) to balance the workload. Each major program element entails substantial partnerships among the laboratories and between the laboratories and the production plants. It is a shared effort requiring the special capabilities and the unique facilities at each site in the complex.

These program integration efforts are tied to formal processes with the Department of Defense (DoD) for validating assessments of stockpile performance and modification actions. The ultimate measure of Program success will be our continuing ability to assure the President on a yearly basis the safety and reliability of the stockpile without nuclear testing. As one of the two nuclear design laboratories, Livermore has essential responsibilities in formal validation and certification activities. In the past, validation and certification was greatly assisted by nuclear testing—the final arbiter. Now it depends on formal review of the technical assessments of personnel in the Program. The process is greatly strengthened through the use of expertise and capabilities at each of the laboratories and independent evaluations—widely referred to as "peer review."

Validation requires expert judgments about nuclear weapons issues and the technical evidence gathered. This is particularly complicated because of the uniqueness of the enterprise. For security reasons, only a small community of people have the necessary expertise and access to tools to deal with the intricate classified details of modern nuclear weapons. In addition, many physics and engineering issues are special to the discipline, such as material properties at extreme pressures and temperatures.

Two formal validation processes have been established: Dual Revalidation and Annual Certification. Dual Revalidation is a formalized peer review process, developed in consultation with the DoD, to assess the condition of U.S. stockpiled weapons. Two teams perform the evaluation, one with personnel from the laboratory that originally designed the weapon and the other with experts from the second nuclear design laboratory. Sandia participates on both teams. Each Dual Revalidation is managed by a DoD/DOE Project Officers Group and is expected to take two to three years to complete. The W76 warhead is the first system undergoing Dual Revalidation.

Annual Certification was established in response to Presidential direction for a yearly assessment from the Secretaries of Defense and Energy on the safety and reliability of the stockpile under a Comprehensive Test Ban Treaty and on the need to conduct a nuclear explosive test. This certification is based on technical evaluations made by the laboratories and on advice from the three laboratory Directors, the Commander in Chief of the Strategic Command (CINCSTRAT), the Chairman of the Joint Chief of Staff, and the Nuclear Weapons Council. On February 7, 1997, the two Secretaries reported to the President that the stockpile remains safe and reliable and that nuclear testing is not required to certify weapon performance this year.

Livermore devoted significant effort to prepare for this first Annual Certification, and we found the process to be extremely valuable. Most important, it provided a focus for our stockpile stewardship and life extension activities and strongly reinforced their crucial contribution to national security. It also fostered considerable inter-laboratory consultation and cooperation. To prepare for the Annual Certification, we collected and analyzed all available information about each stockpile weapon system, including physics, engineering, and chemistry and materials science data. This work was subjected to rigorous, in-depth intra-laboratory review and summarized in Technical Certification Reports for the DOE. As Director of our Laboratory, I approved those reports for Livermore's weapon systems after an intense series of reviews last July.

Our preparations for the Annual Certification were also scrutinized by a team of experts assembled by CINCSTRAT (the so-called "Green Team"). As part of DoD's active and important role in certification, STRATCOM hosted two three-day meetings in June and July to review presentations made by the laboratories and the services. The Green Team report to CINCSTRAT provided an important basis for DoD's assessment of the stockpile.

An important byproduct of this formal, structured evaluation of the stockpile is the recognition that there are opportunities to enhance the performance margin of some systems as required modifications are made to extend their lifetime. We intend to make this evaluation of enhanced performance margins a part of our stockpile life extension activities.

Enhanced Surveillance

Our stockpile surveillance efforts focus on Livermore designs in the enduring stockpile: the W87 and W62 ICBM warheads, B83 bomb, and the W84 cruise missile. Three of these weapons are the only systems in the inventory with all the modern safety features. We are responsible for weapons in two legs of the strategic triad and, overall, three of the eight weapon systems scheduled to be deployed at the turn of the century. Moreover, our stockpile surveillance activities also build the scientific base and develop monitoring capabilities to better understand aging effects in all weapons in the stockpile.

Aging is a critical issue. It affects the physical characteristics of materials, and we must determine how these changes impact weapon reliability and safety. With a better understanding of aging, our stockpile surveillance can be more predictive, making possible systematic refurbishment and preventative maintenance activities (rather than crash production programs) to correct problems that threaten weapon safety or reliability.

The Aging Effects of Materials in Weapons

Modern nuclear weapons consist of precision manufactured components made from many different types of materials. These include highly reactive metals such as plutonium and uranium as well as organic materials. Organic materials play many important roles in weapons operation. They comprise the high explosives that compress the fissile materials to initiate the chain reaction. Some organics are structural materials and adhesives that maintain precise alignment during high-stress conditions, especially during launch.

Many of the organic materials used in nuclear weapons are very stable under benign conditions. However, in a weapon environment these materials outgas at significant levels because they remain hermetically sealed for many years, experience high temperatures, and are exposed to radiation. The released compounds are indicators of aging, which can affect performance. In addition, they can corrode the highly reactive metals or affect the integrity of other organic materials. Understanding the evolution of the gases in the free volume of a complex nuclear weapon and extrapolating the long-term consequences present severe challenges to our materials scientists.

We have developed a technique for sampling evolved gases within stockpile weapons that is extremely efficient and does not require collecting a bulk gas sample. In a non-intrusive way, the outgassed chemicals are collected and concentrated onto a "microextraction fiber." The fiber is then examined in Livermore's Forensic Science Center, where we are able to detect and analyze minute, complex chemical samples.

We have applied this technique to sample a W87 high explosives surveillance "core" at the Pantex plant. This sealed surveillance core contains samples of the materials in the actual weapon and is periodically examined for evidence of degradation. More recently, we very successfully applied the microextraction technology to sample the free volume in a B83 unit being subjected to routine nondestructive surveillance at Pantex. The technique was well received at the plant because no external energy is applied to the system and the procedure is therefore inherently safe. We are currently analyzing the complex mix of gases obtained. This work is being conducted in close cooperation with Pantex as well as Y-12 staff. Results are being shared with Sandia and Los Alamos.

We are also devoting considerable effort to understand aging in plutonium and the effect of aging-related changes on the performance of an imploding pit of a stockpiled weapon. Plutonium is a comparatively stable material in weapons; however, its properties are among the most complex of all the elements. In addition, if remanufacture of plutonium parts is required, we must provide long lead times because of the complex's limited capacity for plutonium operations. We are studying the effects of aging on the microstructure of plutonium in laboratory experiments using minute quantities of material under highly controlled conditions. Activities to assess the impact of changes in plutonium microstructure on performance need to be conducted at NTS. We are working with NTS and Los Alamos to execute a series of subcritical experiments to study the properties of plutonium shocked and accelerated by high explosives. We hope to field the first experiments later this year. Other initiatives which will fully utilize NTS capabilities for the Stockpile Stewardship and Management Program are in the planning stage. These joint laboratory-NTS initiatives will emphasize construction of additional scientific capabilities to expand our understanding of plutonium and research and development leading to the construction of an advanced hydrodynamic testing facility.

Assessment

Assessments of the performance of stockpiled weapons and modification actions must be demonstration-based—that is, grounded on experimental reality and simulations using detailed, calibrated computer models. We are pursuing a balanced and integrated program of computational simulation, fundamental scientific research, and experiments. Nonnuclear testing and fundamental scientific research provide detailed data, which we strive to reproduce in the sophisticated computational models we are building. Once validated to the extent possible, these weapon physics simulations are then used together with the experiments and archival data to guide our judgment about integral stockpile issues.

At Livermore we operate state-of-the-art experimental and computer facilities for the integrated complex. In addition to a number of important but smaller science and engineering facilities, these include:

- *The High Explosives Applications Facility (HEAF)*. HEAF is the most modern facility for high explosives research in the world.

- *The Nova Laser Facility*. Until construction of the National Ignition Facility, Nova remains the world's premier facility for high-energy density physics experiments to evaluate important nuclear weapons issues.

- *The Flash X-Ray Facility at Site 300, and its upgrade to a Contained Firing Facility.* The Flash X-Ray Facility is currently the most capable hydrodynamic test facility in the world. The ongoing upgrade to contain debris from high-explosive experiments will allow us to conduct critically important experiments even if more stringent environmental restrictions are imposed in the future.

- *The Secure and Open Computing Facilities at LLNL*. These facilities meet our core program needs for stockpile stewardship and management and serve as a testbed for the development of high-performance computing hardware and software.

- *The AVLIS Facility and Program*. LLNL has the most advanced capabilities in the world for research and development on key industrial-scale processes involving uranium.

- *The Superblock*. The Superblock includes small but modern facilities for research and engineering tests involving special nuclear materials.

The Stockpile Stewardship and Management Program identifies new experimental facilities and computational capabilities needed to provide continued confidence in the safety and reliability of the U.S. stockpile, now that the nation is no longer conducting nuclear tests. Major investments at Livermore include our next-generation supercomputer as part of the Accelerated Strategic Computing Initiative and the National Ignition Facility.

The Accelerated Strategic Computing Initiative

The Accelerated Strategic Computing Initiative (ASCI) is a tri-laboratory program to dramatically advance our ability to computationally simulate the performance of an aging stockpile and conditions affecting weapon safety. It is a vital component of the Stockpile Stewardship Management Program. We must make major advances in weapons science and weapons simulation code technology, which in turn require major advances in computer performance and information management technologies. Although it will take more than a decade to achieve ASCI's long term goals—up to a million-fold increase in computer speed and data storage capacity—each year the initiative will deliver major new capabilities to support stockpile stewardship.

A central component of ASCI is the accelerated development of highly-parallel, "tera-scale" computers in partnership with the U.S. computer industry. A tera-scale computer performs a trillion operations per second, which, at modest operating efficiency, is a thousand-fold improvement over current capability. The "accelerated" pace of ASCI was demonstrated by the rapid installation of the IBM Initial Delivery system at Livermore and its almost immediate application to real problems. The 512-node SP2 (the largest machine currently available from IBM) was delivered 30 days early, was up and running three days later, and was applied to stockpile problems two weeks after that. The speed with which boxes of components were transformed into a working supercomputer was a direct result of the dedication and close collaboration of the Livermore and IBM personnel involved.

Although we are only in the early stages of developing advanced ASCI weapons simulation codes, the improvements made to date are providing unprecedented capabilities to our weapons experts. For example, we conducted the first 3D calculations of the behavior of actual weapons systems under the combined effect of hydrodynamics and radiation flow. The code was tested out with experiments on the Nova laser system and then used for predicting the ignition characteristics of fusion target designs and for calculations to increase our confidence in the stockpile. In addition, we completed the most highly resolved 3D calculations of the hydrodynamic behavior of weapon systems yet carried out. The ability to simulate in 3D the coupled thermal-chemical-mechanical-hydrodynamic behavior of weapons in abnormal environments (e.g., a weapon in a fire) is also now available for the first time. Although the power of our current computer/code combinations is only a small fraction of the ASCI goal, it far surpasses all previously available capabilities.

Developing algorithms and simulation codes that can exploit large-scale parallelism of these new computers is one of the major challenges facing the ASCI code teams. Significant progress was made this year at Livermore. For example, we achieved hundred-fold speedups (relative to a Cray YMP) for 3D hydrodynamics calculations on our new IBM machine. We have developed and demonstrated a deterministic radiation transport algorithm with excellent parallel scaling properties—a success that allayed a major source of concern about our ability to effectively use massively parallel processors. In addition, using a new parallel mesh generator, we created a 900 million zone 3D mesh in less than ten minutes, a task that previously would have taken weeks to accomplish.

More accurate simulations of weapons performance require a better understanding of material properties. Taking a “multi-scale” approach, we are conducting atomic-scale materials simulations on our new IBM machine to develop more accurate models of material properties for use in larger-scale simulation codes. We have already achieved breakthroughs in our understanding of the behavior of key materials. For example, we have greatly improved our understanding of phase changes in actinides (e.g., plutonium) through first-principles modeling. We have also improved our understanding of conditions leading to materials failure under shock-loading conditions from our atomic-level simulations. Further use of this “multi-scale” approach to predicting material behavior is vital to stockpile stewardship’s long term success.

We are also making major strides in creating the “tera-scale” problem solving environment needed to take full advantage of the power of ASCI computers. For example, a critical “choke point” in using tera-scale computers is the availability of very-high-speed archival storage for rapid storage and retrieval of the massive amounts of data these computers produce. Livermore led the formation of a consortium of hardware vendors, other government laboratories, and academia to develop the High Speed Storage System (HPSS) and meet this critical need. The first production version of HPSS is now available and has been installed at Livermore and at other supercomputing sites sponsored by DOE, NSF, and NASA.

In addition, Livermore is leading ASCI’s Academic Strategic Alliances Program (ASAP), aimed at developing long-term partnerships with the academic community to meet the challenges of stockpile stewardship. The goal is to establish large-scale computational simulation as a viable methodology in science and engineering and to accelerate advances in key technology areas. The largest component of ASAP is a multi-million dollar, multi-year program to create university Centers of Excellence where large-scale simulation will be applied to complex, multi-disciplinary problems relevant to stockpile stewardship. Over forty preliminary proposals to participate have been reviewed. Final proposals will be evaluated and the first Centers will be established in the next few months. Rapid expansion of these collaborations with the academic community will require additional Program support.

The National Ignition Facility

Livermore has the lead role in the development of the National Ignition Facility (NIF), a cornerstone of the Stockpile Stewardship and Management Program. It will be the only facility capable of well-diagnosed experiments to examine fusion burn and study weapon processes at nuclear-weapons relevant temperatures and pressures. Advanced computer models being developed for stockpile stewardship must be tested in the physical conditions that only the NIF can provide. The NIF project continues to receive positive recommendations from every independent expert group that closely examines its technical and policy merit and/or its readiness to proceed.

A multilaboratory design team from Livermore, Los Alamos, Sandia and the University of Rochester completed Title I engineering design of the NIF this year. As a result of this work, DOE refined the baseline NIF design to enhance the experimental capabilities of the facility. The new baseline design provides options for greatly increasing the experiment rate, higher laser intensities (for higher temperatures), a direct drive capability, and an enhanced capability for radiation effects experiments that support a 1996 Memorandum of Understanding between DOE's Defense Programs and DoD's Defense Special Weapons Agency. It also includes a clean optics assembly capability that had been identified at the time of the conceptual design but not included or costed in the non-site-specific design. In addition, the new baseline design allows weapons physics experiments to begin two years before the end of project construction by utilizing the first bundle of laser beams to be installed. This initial capability (equivalent to approximately twice Nova's capability) can be available by the end of 2001, with project completion now scheduled for the end of 2003.

These important project improvements result in a modest 10% cost increase, including a one year stretchout of the project. The DOE selected this spending profile to most efficiently manage the project within existing budget constraints. The Total Project Cost is now $1.199 billion (compared to $1.074 billion for the conceptual design in 1994). The new project baseline has been validated by an independent industrial evaluation team commissioned by the DOE.

To keep the NIF on schedule, $197.8 million in construction funds needs to be obligated in FY 1998. In addition, $31.3 million in operating funds (included in the Inertial Confinement Fusion Program request) are needed. The Administration has requested $876.4 million for NIF construction in FY 1998, which represents the entire remainder of the construction budget. The funds would, of course, be spent over the six-year time period from FY 1998 through FY 2003.

We are partnering with U.S. industry to design and build the NIF. In 1996, 25% of the project funds costed were with industrial partners, including architect-engineering and construction management firms, engineering design companies, and optics manufacturers. In 1997 we expect to contract to industry more than $150 million in NIF-related work. Overall, about three-fourths of the NIF funds will be committed to industrial contracts. The impact of NIF construction was recently studied by Bay Area Economics, in association with the Berkeley Roundtable on the International Economy and the Institute of Urban and Regional Development, both at the University of California, Berkeley. The study concluded that the new technologies and manufacturing processes acquired in building the NIF will have far-reaching benefits to industry. These new technologies and processes will be available to our industrial partners for a wide range of commercial uses after NIF needs are met.

We are also partnering with the French CEA-Division Applications Militaire and the British AWE-Ministry of Defence on the NIF project. The French have paid more than $50 million directly and are also supplying a share of the laser development necessary for both our NIF and their mega-joule laser project. The British are considering the construction of a smaller facility (32 beamlines instead of the NIF's 192) and they are helping with some aspects of component development. Both France and the U.K. have strong commitments to stockpile stewardship programs in which laser facilities play important roles.

Our appreciation of the value of the NIF for stockpile stewardship continues to grow. Because of the capability for extremely precise measurements in laser experiments, the NIF will be important for studies of the physics of nuclear weapon primaries as well as secondaries. Experiments conducted this year with Nova indicate that the NIF will be able to obtain data relevant to the performance of primaries. In addition, in other Nova experiments we achieved much higher radiation temperatures than previously attained with Nova, leading us to expect that the NIF will reach very much higher temperatures. Also, we are conducting experiments to better estimate and to improve the gain of targets in Inertial Confinement Fusion (ICF) experiments with NIF. The ICF Program has achieved its principal goals to demonstrate sufficient confidence that the targets on the NIF will ignite. Current experiments are further increasing this confidence.

We are also encouraging increased use of our Nova laser by academic investigators. In 1996, 10% of the shots on Nova were allotted to university users. Nineteen proposals were submitted from universities and time was granted to nine investigators in a broad range of scientific fields. In 1997, the number of university proposals increased to 29 and again nine were selected.

Manufacturing

Livermore is the design laboratory for four weapon systems in the enduring stockpile. For the Livermore-designed weapon systems being retired we have a continuing active responsibility to ensure safe and timely dismantlement and disposition of excess materials. Dismantlement of the W68 SLBM warheads and the W71 ABM warheads was completed in 1995. In 1996, we completed dismantlement of the W48 artillery projectiles, the W55 SUBROCs, and the W70 Lance warheads. Plans call for dismantlement to begin soon on the W79 artillery projectiles and the W56 ICBM warheads.

Livermore's responsibilities for the enduring stockpile include the B83 bomb, the W84 cruise missile warhead, and the W87 ICBM warhead. These systems are expected to remain in the stockpile well past their originally anticipated lifetimes. In addition, we are responsible for the W62 ICBM warhead, which is to remain in the active inventory past the end of the decade.

We are developing comprehensive plans to extend the stockpile life of all four of these systems. To this end, significant effort is being expended on their surveillance, maintenance, and selective refurbishment. In particular, Livermore is teaming with the plants to develop and provide greatly improved manufacturing technologies for stockpile life extension of weapon systems. As part of our commitment, we have signed a cooperative agreement with Savannah River, we have nearly completed a similar agreement with Pantex, and we have begun discussions with the Y-12 and Kansas City plants.

At present, extensive infrastructure and operational issues exist at the plants. We face the prospect of widespread degradation of production capability in aging facilities with outmoded equipment. But we also see a major opportunity to introduce advanced manufacturing technology, improve production yields, and greatly lower costs in the long run. The four plants and three laboratories are formulating an initiative to take advantage of this opportunity.

W87 Stockpile Life Extension

We have ongoing activities to extend the life of the W87. The objective is to enhance the structural integrity of the W87 so that it may remain part of the enduring stockpile beyond the year 2025 and will meet anticipated future requirements for the system. The W87 warhead/Mk21 reentry vehicle (RV) is the leading candidate for a single RV option for the Minuteman III ICBM. It is the most modern and safe U.S. nuclear warhead. It incorporates all “Drell” safety features: Insensitive High Explosive, a Fire Resistant Pit, and an Enhanced Nuclear Detonation Safety.

The W87 Stockpile Life Extension Program (SLEP) is exercising many aspects of the nuclear weapons complex and providing a model for stockpile stewardship and management in action. Livermore has worked closely with the Air Force, the DOE production agencies and plants, and the other weapons laboratories to ensure that the designed warhead alterations can be made at the plants and that the resultant product meets the customer’s requirements.

Interactions with the DoD include a detailed examination of the current operating environment of the W87/Mk21 and projections of how that environment might change in the future. W87 SLEP activities have included flight testing, ground testing, and physics and engineering analysis. We have worked with Space Command and defense contractors to interpret and apply the data obtained. These activities have been coordinated by a Joint DoD/DOE Working Group under the direction of the Nuclear Weapons Council.

W87 refurbishment activities involve the Pantex, Kansas City, and Y-12 plants. We involved the plants early in the design phase of the SLEP to ensure that the developed design meets performance requirements and can be produced efficiently, cost effectively, and with high quality. Operations at the Y-12 plant have provided the greatest challenge for the W87 SLEP because of the suspension of many operations at that facility.

In consultation with Y-12 engineers and facility managers, we developed a proof-of-principle system for the laser cutting of high value components. The demonstration system used an ultra-short-pulse (one femtosecond or 10^{-15} sec) laser technology that was originally developed as a Laboratory-Directed Research and Development (LDRD) activity within the ICF program at Livermore. The laser used in the proof-of-principle demonstration holds the world record for highest average power (one petawatt or 10^{15} watts) for the ultra-short pulse duration. These pulse characteristics minimize the amount of material lost and damage to surrounding material in the cutting operation.

The demonstration was conducted in an environmentally controlled workstation designed and built at Livermore in cooperation with Y-12 personnel. The system was designed, fabricated and operated within six months. This team is leading the development of an even higher power system for installation in the Y-12 plant by the end of FY 1997.

Development of the production laser cutting workstation has involved U.S. industry, universities, and other DOE laboratories. In the process, many new applications of femtosecond laser cutting technology have been identified for development. Commercial and DoD organizations are interested in using this technology where conventional cutting technologies will not work. Potential applications include precision slicing for the microelectronics industry, precision hole-drilling for the automotive and aerospace industry, and the demilitarization of mines and chemical and biological warheads.

A unique feature of the laser cutting workstation is the control system, which is being designed to have nested levels of diagnostic capability. An operator need only access a simple main control panel to conduct the laser cutting, whereas a laser scientist can access diagnostics deep within the workstation to examine the performance of various laser subsystems. The controls are also being designed so that the workstation laser can be monitored from Livermore via a “Secure Internet.” Secure Internet connections between the laboratory and the Y-12 plant have already been used to exchange draft design information for the workstation. This remote monitoring capability will enable Livermore scientists and engineers to observe cutting operations, monitor the performance of the various laser subsystems, and ensure that the system is operating reliably. Such technologies are helping to bridge the geographical distance between the laboratories and the plants.

STEMMING THE PROLIFERATION OF WEAPONS OF MASS DESTRUCTION

The proliferation and potential use of nuclear, chemical, and biological weapons, collectively referred to as weapons of mass destruction (WMD), threatens the security of the nation and indeed the world. As Senator Sam Nunn stated, “the number-one security challenge in the United States, now and probably for years ahead, is to prevent these weapons of mass destruction, whether chemical, biological, or nuclear—and the scientific knowledge of how to make them—from going all over the world, to rogue groups, to terrorist groups, to rogue nations.”

The breakup of the Soviet Union signaled the end of the Cold War and brought an end to the bilateral tensions that dominated U.S. national security policy for decades. The revelations of Iraq’s extensive and previously undetected efforts to develop nuclear, chemical, and biological weapons brought the threat of WMD proliferation to center stage in the global security arena. At least 20 countries, some of them hostile to the U.S., are suspected of or known to be developing WMD. In addition, the increasing potential availability of WMD materials (for example, nuclear materials from dismantled Soviet weapons) and WMD know-how (for example, through the Internet) makes terrorist acquisition of such weapons frighteningly possible.

National security rests on the twin pillars of (1) deterring aggression against the U.S.—through diplomacy, treaties, and military strength— and (2) reducing the threats posed by others—by stemming and countering the proliferation of weapons of mass destruction. Both national security thrusts involve a complex combination of policy and technology. Livermore is applying its nuclear expertise, developed through its past work in nuclear weapon development and testing and through its continuing stockpile responsibilities, to the challenge of nonproliferation. Because the threat of proliferation is not restricted to nuclear weapons and in response to recent legislation calling for enhanced U.S. capabilities against WMD proliferation, we are also developing the technologies, analysis, and expertise needed to help stem the proliferation of chemical and biological weapons. These activities build on our Laboratory’s large investment in chemical and biological sciences. In addition, we have established a Center for Global Security Research to bridge the gap between the technology and policy communities and explore ways in which technology can enhance international security.

Livermore’s Nonproliferation Program

Livermore’s program in nonproliferation, arms control, and international security (NAI) is tackling the increasingly serious problem of WMD proliferation across the entire spectrum of the threat—prevention, reversal, response, and avoiding surprise. Recent accomplishments in these areas are highlighted below.

- *Proliferation Prevention and Arms Control*. This program element focuses on the prevention stage. It integrates our activities, capabilities, and technologies for nuclear material protection, control, and accountability. It also combines our treaty verification technology R&D with policy analysis and support for U.S. arms control activities. International cooperative efforts, particularly with Russia and China, are an important aspect of this program.

- *Proliferation Detection and Defense Systems*. This program element concentrates on proliferation reversal. Here, our work to develop detection technologies is integrated with critical systems analysis so that advanced technology can be optimized for operational settings. Technologies and analyses to identify, assess, and counter proliferant activities are central to this program.

- *Counterterrorism and Incident Response*. This program element deals with the response phase. Long-standing Livermore capabilities in nuclear emergency response are augmented with similar capabilities for chemical and biological weapon emergencies. The program focuses on the application of technologies and operational capabilities to respond to WMD emergencies or terrorist incidents.

- *International Assessments*. This program element addresses the need to avoid surprise regarding foreign WMD activities. Livermore expertise in nuclear weapons science and technology is central to this work. Multifaceted analyses incorporating technical, economic, political, and other drivers are conducted in collaboration with the U.S. intelligence community to evaluate foreign weapons programs.

Proliferation Prevention and Arms Control

Clearly, the U.S. wants to be proactive, not reactive, in dealing with the threat of proliferation and wherever possible stop proliferation at its source. Although the ubiquitous nature of chemical and biological weapon materials presents special challenges, technologies and protocols for tracking, control, and accountability of nuclear materials can provide effective means for preventing the spread of nuclear weapons.

Nuclear Materials Tracking and Accountability

We continue to collaborate with research and manufacturing facilities in the former Soviet Union to improve the protection, control, and accounting of nuclear weapons materials stored or processed at those sites. This work, part of the DOE's Material Protection, Control, and Accounting Program, represents a major U.S. effort to reduce the potential for unauthorized transfer or theft of nuclear materials from the numerous stockpile sites within the former Soviet Union. We are currently involved in activities at more than 40 sites and have recently begun working with the Russian navy and the Murmansk Shipping Company to enhance the protection of fuel for their nuclear-powered vessels.

We are also working with our Russian counterparts to reduce the inventories of nuclear weapons materials of both countries. Mutual reciprocal inspections are an essential first step. The official Mutual Reciprocal Inspection (MRI) Agreement was signed in March 1994 by U.S. Secretary of Energy O'Leary and Minister of the Russian Federation for Atomic Energy Mikhailov. The agreement commits the two countries to develop methods to confirm each other's inventory of fissile material created by the dismantlement of nuclear weapons and to carry out inspections of both inventories using those methods. This agreement is part of the Safeguards, Transparency, and Irreversibility effort, backed by U.S.–Russian summit declarations, to increase both governments' confidence in their knowledge of each other's nuclear weapons and fissile material stockpiles.

When the MRI Agreement was signed, mutually acceptable inspection methods had to be developed that could verify the weapon origin of inspected nuclear components without compromising sensitive information. In November 1996, we hosted a delegation of Russian technical experts to carry out joint measurement experiments on unclassified plutonium components in Russian and U.S. storage containers. Also present were scientists from Los Alamos as well as representatives of DoD, DOE, and other U.S. government agencies. The measurement methods evaluated were passive neutron detection and gamma-ray imaging. As a result of this exercise and an earlier exchange in 1994 (also held at Livermore), the technical concerns about mutual reciprocal inspections have been evaluated, preparing the way for a political decision about implementation of the MRI Agreement.

Nuclear Smuggling

Large quantities of surplus nuclear materials are resulting from the dismantlement of thousands of nuclear weapons by both the U.S. and Russia. The enormous amount of material that must be stored or disposed of, as well as the rapid changes that are occurring in the former Soviet Union, cast doubt on the ability of existing controls to keep nuclear material from falling into the hands of potential proliferants. We are participating in a major DOE program to upgrade nuclear material protection, control, and accountability in the former Soviet Union.

The wide availability of nuclear weapon information, together with the potential availability of nuclear materials through illicit trafficking, makes it all too possible that nuclear materials or devices could find their way into the hands of rogue states or terrorists. Indeed, in 1995, 2.7 kilograms of highly enriched uranium was intercepted in Prague. In the event that facility-based material protections are circumvented, interdiction, assessment, and attribution capabilities must be brought to bear.

The first-ever counter-nuclear smuggling exercise, coordinated by Livermore, was held in July 1996 to assess existing domestic capabilities in nuclear forensics. Eight DOE laboratories participated, together with other government agencies that would be involved in such an incident. According to the scenario chosen for this exercise, U.S. Customs has intercepted a package containing radioactive material. The laboratories are called upon to analyze and characterize the confiscated materials and provide results to help guide further law-enforcement and diplomatic activities.

A mock contraband package, containing a variety of residues, particles, and actual nuclear materials, was prepared at Livermore for forensic analysis. The package was treated as if it were actual evidence associated with a law-enforcement investigation. The participating laboratories subjected samples of the "contraband" to various analyses to determine the type of nuclear material, the possible source of the material, and any other information about the sample or the persons involved.

From the sum of the laboratories' results, the package was correctly identified to contain highly enriched uranium coated with the insensitive high explosive TATB. The exact composition and combination of materials provided indications as to the origin and function of the weapons material. Other identifications provided information that law-enforcement and intelligence agencies could use in their efforts to trace the source of the contraband and identify the perpetrators.

This exercise was extremely valuable. It helped establish a technical baseline among the U.S. nuclear forensics community, and it demonstrated our ability to make timely analyses of suspect material and reasonable assessments of the material's origin. The results of this exercise will help guide future efforts to counter nuclear smuggling, both by the technical community and by the policy organizations concerned with the assessment of the possible sources and routes associated with confiscated nuclear materials.

Proliferation Detection and Defense Systems

The second phase in countering WMD proliferation is to detect weapons-related activities and to evaluate options for denying WMD to the potential proliferant. Livermore strengths in advanced instrumentation and computational simulation are particularly valuable here. Our achievements in detection and monitoring instrumentation have been well reported in recent years. We have developed and fielded various sensor systems, including a passive system called INSENS that is being developed for the U.S. Naturalization and Immigration Service. We also have a number of other systems—passive and active, on-site and remote, ground-based and airborne—in various stages of research and development.

In the area of evaluating options for deterring or reversing WMD proliferation, we make heavy use of computational simulation. For example, we have developed a versatile and powerful modeling system for analyzing the proliferation activities of foreign countries and evaluating the consequences of possible interdiction options, including environmental and socio-economic effects. These analyses provide valuable technical input to the decision makers who must determine the U.S. response to such activities. With this Counterproliferation Analysis and Planning System, we can model the various processes (chemical, biological, metallurgical, etc.) which others use to build weapons of mass destruction and their delivery systems.

Drawing upon information from many sources (e.g., the U.S. intelligence community, international commercial databanks, private industry), we can generate models of a specific country's proliferation activities. We can identify the function and location of suspected production sites; in some cases, we can even model the layout of individual facilities. By modeling proliferation activities at this level of detail, we can analyze the country's specific approach to weapons production. We can then identify critical processing steps or production facilities which, if denied, would prevent that country from acquiring weapons of mass destruction.

We are augmenting this analysis system with demographic data and atmospheric plume models developed for Livermore's National Atmospheric Release Advisory Capability. This upgrade will allow us to analyze collateral damage resulting from possible interdiction actions, including such socioeconomic and environmental consequences as civilian injuries, crop loss, and damage to water aquifers. We are also building a suite of chemical databases that will allow us to evaluate the effects of industrial chemicals that could be released into the environment as the result of interdiction actions against proliferant sites.

These counterproliferation analyses are an important contribution to the U.S. Strategic Command in its role as a support command in counterproliferation. We also support counterproliferation exercises and planning by the U.S. Special Operations Command, the Air Force, the Department of State, the Defense Intelligence Agency, and the Central Intelligence Agency.

Counterterrorism and Incident Response

The third phase in dealing with the threat of WMD proliferation is to counter and respond to actual WMD use or threats of use. Effective response requires the integration of analysis, technologies, and operations. We are working with DOE, Los Alamos and Sandia, and the other government agencies that would be involved in responding to a WMD incident.

Chemical and Biological Weapons

The threat posed by chemical and biological weapons is real and growing. DOE initiated the Chem/Bio Nonproliferation Program to exploit the national laboratories' unique technical expertise to develop effective capabilities for dealing with a chemical or biological weapon threat. Livermore is contributing in six areas: bioinformation, point detection, standoff detection, transport and fate, decontamination, and systems analysis. Although this program has just begun, we have already demonstrated significant advances in field detection and identification of simulants.

In October 1996, a team of LLNL scientists and engineers took part in a Joint Field Trial held at Dugway, Utah. In this exercise, participating teams analyzed 1600 samples over a period of ten days in a field laboratory setting. Four simulant materials were used, representing typical biological weapon materials. We tested two instruments, a mini-flow cytometer and a mini-PCR (polymerase chain reaction) instrument. We were extremely pleased with our results, particularly since this was the first use of a mini-PCR instrument in a field test.

Our mini-flow cytometer achieved a positive identification for 87% of the samples, with an exceptionally low "false positive" rate of only 0.4%. This level of successful identification was achieved for samples ranging over a factor of 1000 in concentration and at a very high rate of analysis (less than one minute per sample for flow cytometry, for a throughput of 160 samples per day). Despite the outstanding performance of this instrument, we are modifying it to further increase sensitivity, accuracy, speed, and throughput.

Our mini-PCR instrument was demonstrated for the first time at the Dugway test. PCR instruments use DNA replication techniques (specifically, PCR) to amplify minute samples of DNA and provide specific identification of individual organisms. Unlike typical laboratory PCR instruments, which are bulky and require large power sources, our mini-PCR fits inside a large suitcase, runs on batteries, and can be carried into the field and used for *in-situ* analyses. At the time of the Dugway test, this particular instrument had been in development for only a few months. It was able to process 40 samples a day. Although the accuracy of detection and false positive rate for this instrument are not yet acceptable, our mini-PCR holds definite promise for high-speed, high-specificity field analysis of biological weapon agents.

A prototype instrument, identical to the one tested at the Dugway trials, has been delivered to the DoD. New mini-PCR instrumentation is being designed and developed at Livermore in collaboration with the DoD and other government agencies. We plan to return to Dugway in the fall of 1997 to test the improved instrument.

WMD Terrorism

Also this past year, we contributed to a study of the threat of terrorist use of WMD against the U.S. Although the U.S. has not yet been the target of a terrorist attack using WMD, the threat is real and increasing. The World Trade Center and Oklahoma City bombings demonstrate an apparent willingness or desire on the part of terrorists to cause mass casualties. A dangerous precedent for terrorist use of WMD was set by the March 1995 nerve-gas attacks in the Tokyo subways. Preparing for and responding to the threat of WMD terrorism should be one of our highest national security priorities.

An end-to-end strategy is needed for detecting, defending against, and responding to the WMD terrorism threat. It is a very complex threat, and a number of enhanced technologies and operational measures should be developed and deployed. These run the gamut from indicators of biological or chemical signatures of weapons development (as has been done for nuclear weapons) to technologies for dealing with the weapons once found.

Livermore and the other DOE laboratories have relevant expertise and capabilities in many of these areas. For example, the laboratories are developing technologies for rapidly identifying biological pathogens, which would enable early detection of a biological attack and the possibility of taking significant protective measures. In addition, advanced forensics capabilities at the laboratories could identify the perpetrator, which helps deter acts of WMD terrorism or respond if an act is committed. These and other examples illustrate how Livermore can contribute to national efforts responsive to this serious threat to U.S. security.

International Assessments

For decades, Livermore has applied its in-depth technical knowledge of the design and testing of nuclear explosive devices to assess foreign nuclear weapons programs. The goal of these efforts is to avoid WMD-related surprise while the U.S. seeks to prevent, reverse, and respond to weapons proliferation threats worldwide.

At Livermore, we are assessing nuclear proliferation risks in key areas of the globe—the Middle East, North Africa, South Asia, and East Asia. In addition, we analyze the status of stockpiles of nuclear weapons and weapons materials of the declared nuclear weapon states.

Our assessment capabilities proved particularly valuable in 1995–1996, as the CTBT was being finalized. During this period, France and China conducted a series of nuclear tests. We were also concerned about nuclear activities of “threshold” states. (Threshold states are those countries that are believed to have a nuclear weapons capability but are not conducting an active nuclear test program.) In this same time period, we intensified our assessment effort of the Indian test site to search for indicators that would clarify India’s nuclear test intentions. Our findings and analysis were provided to policy makers as input to their subsequent diplomatic actions.

In all of our international assessments, we draw on our general technical knowledge about nuclear testing, specifics about each country’s nuclear capabilities, and our understanding of nontechnical issues that motivate nuclear programs. In this way, Livermore analysts support the U.S. intelligence and policy communities and provide technical assistance to policy makers and diplomats as they developed strategies for the U.S. response to international activities.

Center for Global Security Research

In recognition of the fact that technical issues comprise only a portion of the nonproliferation and counterterrorism picture, we established the Center for Global Security Research. Our objective through this center is to bridge the gap between the technology and policy communities by analyzing and understanding factors that can reduce the threat of weapons of mass destruction and by evaluating how technology can enhance the international security framework. Topics are chosen for study which leverage the talents and resources at Livermore, while utilizing unique capabilities brought to the Center by visiting scholars.

Our Center for Global Security Reseach collaborates with a broad spectrum of organizations engaged in similar work, including others within the University of California, other security research centers in academia, U.S. government agencies, and private institutions worldwide.

The Center sponsors research in areas such as the security implications of emerging technologies, technical options for reducing the WMD threat, threat anticipation and management, and the future role of military forces. For example, technology and policy are inextricably intertwined in international peacekeeping operations. Military forces of the U.S. and its allies are routinely asked to support the United Nations in various peacekeeping operations, and laboratories like LLNL have a potentially important role to play in enhancing the peacekeeping capabilities of U.S. and allied forces. In September 1996, the Center sponsored a conference, attended by key operational, policy, technical, and military personnel from around the world, on “Meeting the Challenge of International Peace Operations: Assessing and Contribution of Technology.” Another Center-sponsored conference, held in March 1997 at Stanford University, focused on policy and technology implications in “Protecting and Assuring Critical National Infrastructure.” The Center is also supporting studies of the technical and political inhibitions that deter countries from developing nuclear weapons and the technical and political issues involved in humanitarian de-mining.

INSTITUTIONAL AND MANAGEMENT ISSUES

Laboratory Operations

We have taken major steps to improve the way we conduct laboratory business, reduce costs, and shape our workforce to meet existing and anticipated programmatic needs. These efforts continue, full force. In addition, we are working on management and oversight issues through Department-wide efforts and various pilot projects aimed at streamlining excessive DOE rules and regulations and consolidating laboratory audits and reviews. We have made significant progress on a broad range of initiatives. Highlights include:

- *Decreased infrastructure and operational costs*. Over the last five years, we have reduced operational costs by 23%. We began by reengineering a number of operations (for example, procurement). We also developed more accurate information about program costs for laboratory managers, and we chartered and acted on the recommendations of a Cost-Cutting Initiative (CCI) Task Force. This past year alone we reduced the cost to programs by 10% and are now delivering more program value to our customers. We have set the goal of an additional 10% reduction over the next two years.

- *Improved performance*. We have dramatically increased performance in operational activities as we reduced costs. For example, in the area of procurement our performance rating has increased in the last four years from "unsatisfactory" to "far exceeds expectations," even as we cut staff size by more than 25%.

- *Workforce restructuring*. In response to the CCI Task Force, laboratory programs developed detailed information about workforce skills and capabilities and projections of future needs. On the basis of this information, we undertook a workforce restructuring under Section 3161 of the National Defense Authorization Act. More than 500 employees took advantage of a Voluntary Separation Incentive Program. As a result, we have been able to adjust to the skill mix we need with no layoffs. Overall, over the past five years, we have reduced the laboratory workforce by 2700 heads without layoffs.

University of California Management of the Laboratory

The University of California (UC) has been the contractor operating Livermore—as well as Los Alamos and Berkeley—since our beginning. This arrangement has provided great benefit to our Laboratory and the nation. It has been a major factor in attracting and maintaining a high-quality workforce, it has provided an atmosphere in which independent views and technical honesty are treated as core values, and it has led to an array of scientific and technical associations that would have not been achievable otherwise. These are very important qualities to preserve as we face new technical challenges. Negotiations are ongoing to renew the UC-DOE contract. We hope that the relationship will continue.

An exceedingly important part of UC's management role is its President's Council on the National Laboratories. This council oversees all of the scientific work performed at the three national laboratories UC manages. In particular, the National Security Panel of the President's Council provides outstanding service to the nation. The Panel has a very strong influence on the national security activities at the laboratories through its effective reviews of our programs. Its constructive criticism of our scientific work, its probing questions, and its recommendations on how the laboratories can better integrate their efforts are having a major impact on implementation of the Stockpile Stewardship and Management Program.

SUMMARY REMARKS

The DOE Stockpile Stewardship and Management Program is a very challenging undertaking for the national security laboratories and other elements of the nuclear weapons complex. It represents a major change from the design and testing of weapons to a program in which enhanced surveillance of the stockpile, nonnuclear experiments, and computations provide the principle basis for judgments about the safety and reliability of weapons. In addition, the Program demands a smaller but revitalized manufacturing capability. All our activities rely on strong partnerships among the laboratories, the production facilities, the Nevada Test Site, and U.S. industry.

The Stockpile Stewardship and Management Program is off to a good start. We have defined the Program architecture and begun executing detailed implementation plans. We are already beginning to reap significant benefits from the new supercomputers being developed and acquired as part of the Program. We are proceeding with the design and construction of the new experimental facilities which will allow us to pursue the cutting-edge science we need to assess weapon performance and train the next generation of stockpile stewards. Most important, the Secretaries of Energy and Defense were able to assure the nation in the first Annual Certification that the stockpile presently is safe and reliable.

The greatest challenges lie ahead. The demands on the Stockpile Stewardship and Management Program will grow as weapons in the enduring stockpile continue to age. The U.S. nuclear weapons stockpile is now older on average than it has ever been. And, the reservoir of nuclear test and design experience at the laboratories continues to diminish. Program success depends on bringing into operation necessary scientific capabilities while there remain experienced nuclear designers to train the next generation of stockpile stewards. This requires a continuing public investment of approximately $4 billion per year for a decade. It can only happen if there is sustained bipartisan support for the Program from Congress and the Administration. Accordingly, I urge your strong support of the FY 1998 budget submission for Defense Programs. It is imperative that we lay a solid foundation early in the effort to ensure the Program's success. We also must be prepared to increase funding for stockpile stewardship and management should major difficulties arise or opportunities to significantly reduce overall Program risk.

I also urge your vigorous support for the program proposed by the Office of Nonproliferation and National Security and for the programs and initiatives of other agencies in the area of WMD nonproliferation and counterterrorism. The enormity of the challenge cannot be overstated. As Defense Secretary William Cohen has said, "the proliferation of weapons of mass destruction presents the gravest threat that the world has ever known."

Addressing the problem of WMD proliferation requires a complex integration of technology and policy across the entire spectrum of the threat—from prevention and reversal to response and avoiding surprise. As I have highlighted, Livermore is making significant contributions, through nuclear weapons and nuclear test expertise, technical assistance to the former Soviet Union on nuclear materials control, advanced technology development, intelligence analyses, and policy assessments and support, that are enhancing national and global security. As funding permits, we are prepared to make even greater contributions to national WMD nonproliferation and counterterrorism efforts.